

### **REMARKS**

The amendment to the Table on page 23 of the specification serves only to correct the information contained in the Table such that it corresponds to the description of Example 7 in the specification on page 20, lines 9-20. More specifically, the Table on page 23, under the column labeled "Process" inadvertently identified the prepolymer of Example 7 as being prepared from Terethane® and Cyagard instead of being prepared from Terethane® and MDI. Support for this amendment can be found in the specification on page 20, lines 10-12 which clarifies that the prepolymer of Example 7 was the reaction product of Terethane® and MDI.

Support for new Claims 12 and 13 can be found in original Claims 1 and 7 for Claim 12, and in original Claims 2 and 7 for new Claim 13.

Applicants respectfully submit that no new matter has been added by the preceding amendments.

Claims 3-5, 8, 10 and 11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Quiring et al reference (U.S. Patent 4,371,684) in view of the Pelletier et al reference (U.S. Patent 3,474,047), or the Lee reference (U.S. Patent 4,343,914) or the Lee et al reference (U.S. Patent 4,555,562).

The Quiring et al reference (U.S. 4,371,7684) discloses thermoplastic polyurethanes which are suitable for processing in extruders and/or on melt roll calendars. These TPUs are prepared from (A) at least one substantially linear polyols having a molecular weight in the range of from 400 to 10,000, (B) diphenylmethane diisocyanate and/or hexamethylene diisocyanate, and (C) a mixture of 85 to 99% by weight of 1,4-butanediol and 1 to 15% by weight of at least one co-chain extender which is selected from the group consisting of 1,6-hexanediol, ethylene glycol, diethylene glycol, triethylene glycol, neopentyl glycol, 2-ethyl-1,3-hexanediol, 1,3-butanediol, 1,2-propanediol, 1,4-bis-hydroxymethyl cyclohexane, hydroquinone bis-hydroxyethyl ether and mixtures thereof. The amounts of components (A), (B) and (C) are such that the equivalent ratio of NCO-groups in (B)

to Zerewitinoff-active hydrogen atoms in (A) and (C) is from 0.9:1 to 1.2:1, and the molar ratio of components (A) to (C) ranges from 1:20 to 5:1.

Polyurethane compositions comprising the reaction product of polyisocyanates with hydroxyl compounds produced by the reaction of alkylene oxides with phosphonic acid are described by the Pelletier et al reference. Suitable phosphonic acids are monophosphonic acids and diphosphonic acids which correspond to one of the two structures as set forth at column 1, lines 33-44 of the '047 patent. These polyurethanes are disclosed as having improved resistance to burning and flame propagation.

The Lee reference (U.S. Patent 4,343,914) describes flame retardant polyurethanes containing alkyl bis(3-hydroxypropyl)-phosphine oxide. These polyurethanes comprise an effective amount of an alkyl bis (3-hydroxypropyl) phosphine oxide which corresponds to the formula set forth at column 1, lines 43-47, conventional polyols, and one or more polyisocyanates. Typically, a one-shot process is used in the Lee reference.

The Lee et al reference discloses polyurethane elastomer compositions. These elastomer compositions are prepared by curing a NCO terminated prepolymer with a curative. The NCO terminated prepolymer is derived from a polyhydroxy polyether or polyester. Suitable curatives contain a polyhydroxyalkylphosphine oxide that corresponds to the formula as set forth at column 2, lines 38-43.

It is respectfully submitted that the presently claimed invention is not rendered obvious to one of ordinary skill in the art by this combination of references.

The Quiring et al reference does not disclose or suggest to the skilled artisan how to prepare TPUs from MDI prepolymers that have tensile strengths above 35 MPa, low shrinkage (i.e. < 3%), and that are self-extinguishing. Of the working examples in this reference, Examples 1-8 use diphenylmethane diisocyanate and Examples 9-10 use hexamethylene diisocyanate. Examples 9 and 10 are the only examples which use prepolymers. Examples 1-8 are all one-shot processes. Also, of Examples 1-8, only Examples 2, 5 and 6 report physical properties which include tensile strength. From these examples, it is apparent that the tensile strength is not consistently greater than 35 MPa. Also, shrinkage information on these polyurethane elastomers is not given.

Although Examples 9 and 10 report physical properties (see Table 8 at column 8), these TPUs are based on hexamethylene diisocyanate prepolymers. Thus, these TPUs and their properties are not relevant to TPUs prepared from diphenylmethane diisocyanate prepolymers. Of the MDI examples, Example 2 reports a tensile strength of 68 MPa. However, this example does not use a prepolymer of MDI but a one-shot process.

In Examples 5 and 6, Examples 5a, 5b, 5d, 5e and 6d report tensile strengths greater than 35 MPa as required by the present invention. However, these TPUs were also not prepared from a MDI prepolymer, but rather a one-shot process in which the isocyanate was MDI. At column 6, lines 16-21 it is expressly stated that only by following the processing temperatures in a narrow metering range produced a satisfactory tubular file (examples 5c). The tensile strength of Example 5c was only 30.4 (see Table 6 at column 7, lines 10-18) which is clearly below that required by the presently claimed TPUs. In Example 6 of this reference, which used the mixed diol extender required therein, the extrusion of films was acceptable (see Table 5b, bridging columns 6-7). However, as previously stated, only Example 6d had a tensile strength greater than 35 MPa. Accordingly, it is respectfully submitted by Applicants that it is questionable whether one of ordinary skill in the art could reasonably expect to prepare TPUs having high tensile strengths from the Quiring et al reference.

The Quiring et al reference is silent with respect to flameproofing agents as required by the present invention. Thus, none of the TPUs prepared in this reference are self-extinguishing. It is readily apparent that one of ordinary skill in the art has no insight into how to prepare TPUs from MDI prepolymers which exhibit high tensile strengths (i.e. greater than 35 MPa), low shrinkage (i.e. less than 3%) and that are self-extinguishing upon reading this reference.

Combining the Quiring et al reference with the Pelletier et al reference also does not suggest the presently claimed invention to one of ordinary skill in the art. The Pelletier et al reference discloses hydroxyl compounds produced by reacting alkylene oxides with phosphonic acid. In particular, the phosphorus-containing compounds used correspond to one of two structures (see column 1, lines 31-44 of the '047 patent).

The second structure of the Pelletier et al reference is clearly outside the scope of component D) which is required by the presently claimed invention. Thus, it is readily apparent that combining this structure from the Pelletier et al reference with the Quiring et al reference does not result in the presently claimed invention. Accordingly, this combination does not properly render the presently claimed invention obvious and will not be further discussed.

It is, however, possible that the alkylene oxide reaction products of the first structure in the Pelletier et al reference may overlap with compounds of structure (I) in component (D) of the present invention. The compositions produced in the Pelletier et al reference are clearly foams, not TPUs as required by Applicants invention. In addition, although this reference discloses prepolymers of isocyanates, it is specific to prepolymers of toluene diisocyanate (see Example II at column 3, lines 23-30). Obviously, prepolymers of toluene diisocyanate are different than the presently required prepolymers of diphenylmethane diisocyanate. More specifically, however, the prepolymer of Example II of the Pelletier et al reference comprises the reaction product of toluene diisocyanate and the hydroxyl compound formed in Example 1, in which this hydroxyl compound comprises the reaction product of propylene oxide and benzenephosphonic acid. (See column 2, line 69 through column 3, line 18 of the '047 reference.) Thus, the prepolymers in this reference are not conventional prepolymers as in the presently claimed invention. Rather, the prepolymers of the Pelletier et al reference are the reaction product of an isocyanate (specifically TDI) and a hydroxyl compound which contains phosphorus.

Applicants respectfully submit that combining the Pelletier et al reference with the Quiring et al reference does not suggest the presently claimed invention to one of ordinary skill in the art. Rather, this combination of references suggests that prepolymers be prepared from the alkylene oxide reaction products of the phosphorus containing acids of the Pelletier et al reference and the isocyanates of the Quiring et al reference. This is **not**, however, the presently claimed invention.

It is apparent from Examples 4 and 9 in the present application that prepolymers prepared from a phosphorus containing compound and MDI do not result in products that are self-extinguishing. See the Table on page 23. The flame-proof rating is V-2 for both Example 4 and Example 9. In addition, Example 4 has 3%

shrinkage and Example 9 has 4% shrinkage. Accordingly, Applicants respectfully submit that it is not readily apparent to one of ordinary skill in the art from this combination of references that the presently claimed TPUs in which the prepolymer comprises the reaction product of A) MDI and B) a polyol; and the isocyanate-reactive component comprises C) a low molecular weight polyol or polyamine chain lengthener, and D) a phosphorus containing compound corresponding to one of two possible structures, would exhibit high tensile strength (i.e. greater than 35 MPa), a shrinkage of less than 3% and have self-extinguishing properties.

It is evident from Table 1 on page 23 of the present application that TPUs prepared from prepolymers of MDI and a suitable active hydrogen group containing polyol; with a low molecular weight polyol or polyamine, and a phosphorus containing compound consistently yield products which have tensile strengths greater than 35 MPa, shrinkages of less than 3% and are self-extinguishing as illustrated by a V-0 rating. This position is fully supported by Examples 5, 6, 7 and 10 in the Table on page 23. Applicants respectfully submit that the Quiring et al reference combined with the Pelletier et al reference does not fairly suggest the presently claimed invention to one of ordinary skill in the art.

Only after reading Applicants' specification does it become "obvious" to form a conventional prepolymer comprising MDI and an active hydrogen containing compound, and then react the prepolymer with a chain extender (i.e. polyol or polyamine) and a phosphorus containing compound to form a TPU with the desired properties. Such a perspective does not, however, provide a proper basis for a *prima facie* obviousness rejection under 35 U.S.C. § 103(a). Accordingly, it is respectfully submitted that this combination of references does not render the presently claimed invention obvious.

Combining the Quiring et al and the Lee reference also does not suggest the presently claimed invention to the skilled artisan. The Lee reference requires a specific amount of a phosphine oxide compound, and specifically, an alkyl bis(3-hydroxypropyl)phosphine oxide corresponding to the formula set forth at column 1, lines 42-51. It is expressly disclosed by the Lee reference that these phosphine oxides improve flame retardance of polyurethanes prepared by the one-shot process in which a polyol, a polyisocyanate and the alkyl bis(3-hydroxypropyl)phosphine

oxide are reacted (column 2, lines 49-54). Applicants respectfully submit that it is not readily apparent to one skilled in the art from this combination of the Quiring et al reference and the Lee reference how to maintain a good flame retardance while attaining a high tensile strength and low shrinkage.

Upon reading the Quiring et al reference and the Lee reference, the skilled artisan would combine these and react an isocyanate, with an isocyanate-reactive component by a one-shot process. The isocyanate-reactive component would comprise the high molecular weight polyol, a chain extender and the alkyl bis(3-hydroxypropyl)phosphine oxide. Prepolymers of isocyanates are not disclosed or suggested by the Lee reference.

In fact, the working examples of the Lee reference which illustrate the preparation of foams all use the one-shot process in which an isocyanate is reacted with an isocyanate reactive component (i.e. polyol) and the alkyl bis(3-hydroxypropyl)phosphine oxide. See Examples III, III(a), III(b), III(c) and VIII of the Lee reference. It is readily apparent from these examples that prepolymers and the prepolymer process are not suggested to the skilled artisan by the Lee reference.

Applicants respectfully submit that the combination of the Quiring et al reference and the Lee reference lead one of ordinary skill in the art to prepare polyurethanes which may be TPUs or rigid foams by reacting a polyisocyanate, with an isocyanate-reactive component (i.e. a polyol) and the alkyl bis(3-hydroxypropyl)-phosphine oxide of the Lee reference. However, it is readily apparent from the present application, in particular from Example 3 in the Table on page 23, that such a combination does **not** provide a TPU with the required properties! The shrinkage of the TPU prepared in Example 3 was 7%. Nor is it readily apparent to the skilled artisan from this combination of references how to modify the resultant combination "to arrive" at the presently claimed invention. Thus, the presently claimed invention is not rendered *prima facie* obvious by the Quiring et al reference in view of the Lee reference.

Finally, the combination of the Quiring et al reference and the Lee et al reference also does not properly suggest the presently claimed invention to one of ordinary skill in the art.

The Lee et al reference describes polyurethane elastomers formed by curing a mixture of an NCO terminated urethane prepolymer and a polyhydroxyalkylphosphine oxide corresponding to the formula set forth at column 2, lines 35-46. The NCO terminated urethane prepolymers of the Lee et al reference are TDI prepolymers which may be prepared from a polyester, a polyether, and/or a polybutadiene homopolymer. See column 3, lines 4-28 of the '562 reference which describes the TDI prepolymers.

Applicants respectfully submit that combining the Quiring et al reference with the Lee et al reference leads the skilled artisan to prepare TPUs by reacting either TDI prepolymers or HDI prepolymers, with phosphine oxides as disclosed by the Lee et al reference. Even if one was motivated to use MDI instead of TDI, the disclosure of these references does not suggest MDI prepolymers. Thus, the skilled artisan would, at best, upon reading this combination of references be lead to prepare polyurethanes (TPUs) by reacting MDI with a polyol and the polyhydroxyalkylphosphine oxide. This is not, however, the presently claimed invention. It is respectfully submitted that the combination of the Quiring et al reference with the Lee et al reference does not suggest the presently claimed invention to one of ordinary skill in the art. The formation of MDI prepolymers and their subsequent reaction with a phosphine oxide is simply not suggested by this combination of references to one of ordinary skill in the art.

It is apparent from the working Examples of the Lee et al reference that the urethane elastomers prepared do not consistently have high tensile strengths. In fact, of the 9 examples, only Examples 2 and 3 have tensile strengths greater than 35 MPa. The remaining examples (Example 1 and 4-9) all have tensile strengths that are lower than 35 MPa. Example 8 in Table II (column 7) has the next closest tensile strength to that required by the present invention. The tensile strength of Example 8 is about 27 MPa. The Lee et al reference is silent with regard to shrinkage and self-extinguishing properties of the elastomers prepared therein. Accordingly, the Lee et al reference provides no insight into how to prepare TPUs with high tensile strength and low shrinkage, and that are self-extinguishing to one skilled in the art.

Neither the Quiring et al reference or the Lee et al reference clearly suggest MDI prepolymers. Thus, the presently claimed invention is not fairly suggested to

one of ordinary skill in the art upon reading this combination of references. Only after reading Applicants' specification does it become obvious to use prepolymers of MDI. Such a perspective does not, however, provide a proper basis for a *prima facie* obviousness rejection under 35 U.S.C. § 103(a).

In view of the above, it is respectfully submitted by Applicants that one of ordinary skill in the art has no insight into the presently claimed invention upon reading the Quiring et al reference with the Pelletier et al reference, the Lee reference and/or the Lee et al reference. Accordingly, this rejection is improper and should be withdrawn.

Claims 3-5, 8, 10 and 11 were rejected under 35 U.S.C. § 103(a) as being unpatentable over the Batt et al reference (U.S. Patent 6,534,617) in view of the Pelletier et al reference (U.S. Patent 3,474,047), or the Lee reference (U.S. Patent 4,343,914) or the Lee et al reference (U.S. Patent 4,555,562).

The Batt et al reference discloses a method of preparing a thermoplastic polyurethane from (i) a hydrogenated polydiene diol having 1.6 to 2 terminal hydroxyl groups per molecule and a MW of at least about 500 to less than 20,000, (ii) an isocyanate having two NCO groups per molecule, and (iii) one or more chain extenders, and (iv) optionally, a catalyst. These TPUs may have tensile strengths of > 20 MPa. Suitable isocyanates disclosed by the Batt et al reference include MDI, TDI, IPDI, HDI, etc. (see column 2, lines 25-41).

Applicants respectfully submit that the presently claimed invention is not rendered obvious by any of these combinations of references.

Combining the Batt et al reference with the Pelletier et al reference does not suggest the presently claimed invention to one of ordinary skill in the art. Rather, this combination suggests preparing a prepolymer from an isocyanate and the hydroxyl compound which comprises the reaction product of an alkylene oxide and a phosphorus containing acid as described in the Pelletier et al reference. This prepolymer would then be further reacted with one or more chain extenders to yield polyurethanes. It is respectfully submitted that this is not the presently claimed invention. Thus, this combination of references does not render the presently claimed invention obvious under 35 U.S.C. § 103(a).



In addition, as Applicants previously discussed above, this combination does not result in polyurethanes that have a shrinkage of less than 3% and that are self-extinguishing. See Examples 4 and 9 in Table 1 on page 23 of the present application. Both Examples 4 and 9 have UL-94 V ratings of V-2 and shrinkages of 3% and 4%, respectively. These two comparison examples support Applicants position that the present invention is not properly rejected as being over the Batt et al reference in view of the Pelletier et al reference.

Applicants also submit that combining the Batt et al reference with the Lee reference does not suggest the presently claimed invention to one of ordinary skill in the art. As previously discussed, the Lee reference requires a specific amount of the phosphine oxide compound (i.e. an alkyl bis(3-hydroxypropyl)phosphine oxide). In accordance with the disclosure of the Lee reference, the polyol, the phosphine oxide compound and the isocyanate are reacted to form a foam by the one-shot process (column 2, lines 49-54). The Batt et al reference is, by comparison, specific to TPUs prepared by the prepolymer process. It is respectfully submitted that one of ordinary skill in the art would not substitute the prepolymer process for the one-shot process. At best, this rejection is based on an "obvious to try" standard of patentability. It is respectfully submitted that this standard is improper. Thus, this combination of references does not properly render the presently claimed invention obvious.

In addition, assuming that one skilled in the art would "combine" these references; Applicants respectfully submit that the resulting combination is not the presently claimed invention. Since the Lee reference requires that the phosphine oxide be added at the same time as the polyol to the polyisocyanate or prior to reaction of the polyol with the polyisocyanate (see column 1, lines 54-60), the skilled artisan would expect that for the phosphine oxide to be effective when using a prepolymer process, that both the phosphine oxide and the polyol must be reacted with the polyisocyanate to form the prepolymer. Otherwise, the resultant polyurethanes would not exhibit the desired flame retardant properties according to the Lee reference.

Applicants respectfully submit that this combination (i.e. a prepolymer of an isocyanate, a polyol, and a phosphine oxide) is not the presently claimed invention. Also, this combination does not yield polyurethanes which exhibit the desired results.

As Applicants previously discussed, Examples 4 and 9 in the Table on page 23 of the present application clearly illustrate that prepolymers which contain a phosphorus containing compound such as the phosphine oxides of the Lee reference have shrinkages of at least 3% and UL94V ratings of V-2. Although the desired tensile strength of at least 35 MPa can be attained, the other two required properties (i.e. a shrinkage of less than 3% and self-extinguishing as demonstrated by a UL94V rating of V-0) are not satisfied.

It is respectfully submitted that one of ordinary skill in the art has no insight into the presently claimed invention from the combination of the Batt et al reference and the Lee reference. Only **after** reading Applicants' specification does it become obvious to first form a prepolymer from MDI and the polyol, and to react the prepolymer with a chain extender and a phosphorus containing compound. Such a perspective does not, however, provide a proper basis for a *prima facie* obviousness rejection under 35 U.S.C. § 103(a).

Finally, the combination of the Batt et al reference with the Lee et al reference does not fairly suggest the presently claimed invention to one of ordinary skill in the art. First, it is respectfully submitted that the skilled artisan would not combine the Batt et al reference with the Lee et al reference. The Batt et al reference is clearly directed to TPUs and a method for manufacturing these TPUs. By comparison, the Lee et al reference is directed to elastomers. The skilled artisan has no reasonable basis to believe that any of the elastomer formulations described in the Lee et al reference might be suitable for preparing TPUs.

Even if the skilled artisan combined the references as suggested by the Examiner, this would lead the skilled artisan to use the MDI prepolymers from the Batt et al reference, with the curative component (i.e. the phosphine oxides) of the Lee et al reference. Thus, the combination (if made) would lead the skilled artisan to polyurethanes that are the reaction product MDI prepolymers with at least one polyhydroxyalkylphosphine oxide. It is respectfully submitted that this is not, however, the presently claimed invention.

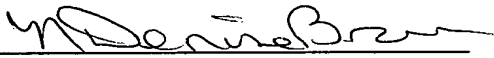
Rather, the presently claimed invention is directed to TPUs comprising the reaction product of a prepolymer of diphenylmethane diisocyanate (MDI), with an isocyanate-reactive component comprising C) at least one polyol or polyamine

having on average at least 1.8 and no more than 3.0 Zerewittinoff active hydrogen atoms and a number average molecular weight of 60 to 400, and D) a phosphorus containing compound which corresponds to one of two specific formulas. The Lee et al reference expressly discloses at column 6, lines 25-29 that the phosphine oxides C-200 and C-300 offer unique properties not usually obtained from either diamine or polyol curatives. Structures of C-200 and C-300 are provided at column 4, lines 25-30.

It is readily apparent that the Lee et al reference requires only the phosphine oxides as curing agents, and in fact, leads the skilled artisan to believe that phosphine oxides alone are better than a combination of phosphine oxides and conventional chain extenders containing hydroxyl and/or amine groups. It is expressly disclosed at column 6, lines 29-34 that these phosphine oxide curatives are about as reactive as MOCA, and give products of intermediate hardness (65 Shore A) and tensile strength similar to MOCA cured materials, and elongation and modulus similar to polyol cured materials. This clearly leads the skilled artisan to use only the phosphine oxides as the curative with the prepolymer, including when the MDI prepolymer of the Batt et al reference is substituted for the TDI prepolymers of the Lee et al reference. Applicants respectfully submit that the presently claimed invention, however, requires the curative component comprise C) a polyol or polyamine of the specified functionality and molecular weight, and D) a phosphorus containing compound corresponding to one of two structures. It is therefore submitted that the combination suggested to one of ordinary skill in the art by the Batt et al reference in view of the Lee et al reference is not the presently claimed invention. Thus, the present invention is not properly rejected as being *prima facie* obvious in view of the Batt et al reference taken with the Lee et al reference.

In view of the above amendments and remarks, Applicants respectfully submit that the presently claimed invention is not fairly suggested to one of ordinary skill in the art by any of the above combination of references. It is therefore submitted that these references do not render the presently claimed invention obvious under 35 U.S.C. 103(a). Accordingly, the withdrawal of the rejection of Claims 3-5, 8, 10 and 11 under 35 U.S.C. § 103(a) in view of the above identified references is requested. Applicants respectfully request that Claims 3-5, 8, and 10-13 be allowed.

Respectfully submitted,

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